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10/762,499	01/23/2004	Aarti Gupta	02011	5224

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EXAMINER

OCHOA, JUAN CARLOS

ART UNIT	PAPER NUMBER
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2123

MAIL DATE	DELIVERY MODE
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05/15/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/762,499	Applicant(s) GUPTA ET AL.	
	Examiner Juan C. Ochoa	Art Unit 2123	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 January 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-74 is/are pending in the application.
- 4a) Of the above claim(s) 1-9, 18-20, 22, 27, 28, 30-54 and 61-74 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 10-17, 21, 23-26, 29 and 55-60 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 1/23/04 is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☒ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. Election filed 1/16/07 has been received and considered, claims 1-74 are pending in this application, claims 10-17, 21, 23-26, 29, and 55-60 have been elected without traverse, claims 1-7, 8, 9, 18-20, 22, 27, 28, 30-54 and 61-74 have been withdrawn as being directed to the non-elected invention. Claims 10-17, 21, 23-26, 29, and 55-60 are presented for examination.

Information Disclosure Statement

2. The listing of references in the specification is not a proper information disclosure statement. 37 CFR 1.98(b) requires a list of all patents, publications, or other information submitted for consideration by the Office, and MPEP § 609.04(a) states, "the list may not be incorporated into the specification but must be submitted in a separate paper." Therefore, unless the references have been cited by the examiner on form PTO-892, they have not been considered.

Oath/Declaration

3. The oath or declaration is defective because:

4. It does not identify the mailing address of each inventor. A mailing address is an address at which an inventor customarily receives his or her mail and may be either a home or business address. The mailing address should include the ZIP Code designation. The mailing address may be provided in an application data sheet or a supplemental oath or declaration. See 37 CFR 1.63(c) and 37 CFR 1.76.

5. It does not identify the city and either state or foreign country of residence of each inventor. The residence information may be provided on either an application data sheet or supplemental oath or declaration.

Drawings

6. The drawings are objected to because of the following informalities:

7. As to Figure 1, terms within logic boxes 101 and 102 are missing a "(".

8. As to Figure 7, legends and terms within logic boxes are not visible/distinguishable.

9. Appropriate correction is required.

10. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because:

11. As to Figure 3, it includes the following reference character(s) not mentioned in the description: 302 and 321.

12. As to Figure 3, it includes the following reference character(s) not mentioned in the description: 403–405, 407, 410, 411, 421, 430, 432, 433, and 441.

13. As to Figure 5, it includes the following reference character(s) not mentioned in the description: 501, 502, 505, and 510.

14. As to Figure 8, it includes the following reference character(s) not mentioned in the description: 804, 822, and 831.

15. As to Figure 9, it includes the following reference character(s) not mentioned in the description: 900 and 902.

16. As to Figure 10, it includes the following reference character(s) not mentioned in the description: 1005, 1007, and 1009.

17. As to Figure 11, it includes the following reference character(s) not mentioned in the description: 1100–1102.

18. As to Figure 12, it includes the following reference character(s) not mentioned in the description: 1200–1202.

19. As to Figure 13, it includes the following reference character(s) not mentioned in the description: 1300–1302.

20. As to Figure 14, it includes the following reference character(s) not mentioned in the description: 1400, 1411, and 1421.

21. Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Objections

22. Claim 17 is objected to because of the following informalities: Claim 17 uses the acronym or variable "SAT", the first use of an acronym or variable in a claim should be defined to avoid any possible indefiniteness issues.
23. Claim 23 includes the miss referenced parent claim "23". Examiner cannot interpret an alternate parent claim for examination purposes, since there is no antecedent method with at least one clause.
24. Appropriate correction is required.

Claim Rejections - 35 USC § 102

25. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –
(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

26. Claims 10–17 and 29 are rejected under 35 U.S.C. 102(a) as being anticipated by Baumgartner et al., (Baumgartner hereinafter), Property Checking via Structural Analysis.
27. As to claim 10, Baumgartner discloses a method determining an abstract sequential circuit model of an original sequential circuit model (see page 7, 3rd paragraph), comprising: a) adding to the original sequential circuit model, interface propagation constraints for each flip-flop to capture equality between an input and output of a flip-flop across successive time frames (see page 8, 2nd paragraph), and an initial value constraint for each flip-flop (see page 3, 4th paragraph, 1st line); b) marking

constraints required for unsatisfiability of external constraints across multiple cycles of operation of the sequential circuit (see page 7, last paragraph and page 8, 1st paragraph); c) forming the abstract sequential circuit by including combinational fanin cones of marked external constraints and flip-flops corresponding to marked interface propagation constraints and flip-flops corresponding to marked initial value constraints (see page 7, last paragraph and page 8, 1st paragraph).

28. As to claim 11, Baumgartner discloses a method determining an abstract sequential circuit model of an original sequential circuit model (see page 7, 3rd paragraph), comprising: a) adding to the original circuit model, interface propagation constraints for each flip-flop to capture equality between an input and output of a flip-flop across successive time frames (see page 8, 2nd paragraph), and an initial value constraint for each flip-flop (see page 3, 4th paragraph, 1st line); b) marking constraints required for unsatisfiability of external constraints across multiple cycles of operation of the sequential circuit (see page 7, last paragraph and page 8, 1st paragraph); c) forming the abstract sequential circuit by including combinational fanin cones of marked external constraints and flip-flops corresponding to marked interface propagation constraints only, and by adding constraints for initial values of flip-flops with marked initial value constraint only (see page 7, last paragraph and page 8, 1st paragraph).

29. As to claim 12, Baumgartner discloses a method determining an abstract sequential circuit model of an original sequential circuit model (see page 7, 3rd paragraph), comprising: a) adding to the original sequential circuit model, interface propagation constraints for each flip-flop to capture equality between an input and

output of a flip-flop across successive time frames (see page 8, 2nd paragraph), and an initial value constraint for each flip-flop (see page 3, 4th paragraph, 1st line); b) marking constraints required for unsatisfiability of external constraints across multiple cycles of operation of the sequential circuit (see page 7, last paragraph and page 8, 1st paragraph); and c) forming the abstract sequential circuit by including combinational fanin cones of marked external constraints and flip-flops corresponding to marked interface propagation constraints only, and by adding lazy constraints for initial values of flip-flops with marked initial value constraint only (see page 7, last paragraph and page 8, 1st paragraph).

30. As to claim 13, Baumgartner discloses a method wherein the abstract sequential circuit is obtained based on a fixed number of time-frame unrolling of the sequential circuit (see page 7, next to last paragraph).

31. As to claim 14, Baumgartner discloses a method wherein the abstract sequential circuit model of the original sequential circuit based on k time-frame unrollings is generated based on an abstract model based on fewer than k time-frame unrollings (see page 7, Fig. 2).

32. As to claim 15, Baumgartner discloses a method wherein the number of time-frame unrollings is increased progressively until the abstract model satisfies some criteria (see page 7, Fig. 2).

33. As to claim 16, Baumgartner discloses a method wherein the number of time-frame unrollings is increased progressively until the abstract model is stable for a certain number of unrollings (see page 7, 2nd paragraph).

34. As to claim 17, Baumgartner discloses a method wherein the number of time-frame unrollings is increased progressively such that if a SAT formula is satisfiable when the number of time-frame unrollings is k and the abstraction was attempted from the abstract model obtained at the n th time frame ($n < k$), an attempt is repeated to obtain the abstract model at the k_{th} time frame starting from an abstract model obtained at a time frame $m > n$ (see page 7, next to last paragraph, last 3 lines).

35. As to claim 29, Baumgartner discloses a method determining an abstract sequential circuit model of an original sequential circuit model (see page 7, 3rd paragraph), comprising: a) adding external constraints to the original circuit model based on a need to check temporal properties of the original circuit and for enforcing environment constraints (see page 13, lines 3–6); b) adding interface constraints to the original sequential circuit model to capture equality between an input and output of a flip-flop across successive time frames (see page 8, 2nd paragraph), including its initial value constraint at depth 0 (see page 3, 4th paragraph, 1st line); c) marking constraints for unsatisfiability of external constraints across multiple cycles of operation of the sequential circuit (see page 7, last paragraph and page 8, 1st paragraph); and d) forming the abstract sequential circuit by including combinational fanin cones of marked external constraints and flip-flops corresponding to only the marked interface constraints (see page 7, last paragraph and page 8, 1st paragraph).

Claim Rejections - 35 USC § 103

36. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

37. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148

USPQ 459 (1966), that are applied for establishing a background for determining

obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

38. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

39. Claims 21, 24, 55 and 58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Baumgartner as applied to claims 10 and 29 above, taken in view of Jin Yang, (Yang hereinafter), U.S. Patent 6,643,827.

40. As to claim 21, while Baumgartner discloses almost all of the instant invention as applied to claim 10 above; Baumgartner fails to disclose at least one constraint corresponding to initial value of a flip-flop applied in a lazy manner.

41. Yang discloses a method wherein at least one constraint corresponding to initial value of a flip-flop is applied in a lazy manner (see col. 3, lines 18–22).

42. Baumgartner and Yang are analogous art because they are both related to design verification.

43. Therefore, it would have been obvious to one of ordinary skill in this art at the time of invention by applicant to utilize the step of Yang in the method of Baumgartner because Yang utilizes lazy pre-image computation, which differs from previous COI reduction approaches in that it is not statically derived from a model specification and then used throughout, to dynamically provide an abstraction for each pre-image computation that is relevant to the particular state predicate associated with the invocation (see col. 5, lines 30–36), and as a result, Yang reports the following improvement over his prior art: greater efficiency and capacity improvements in popular BDD-based symbolic model checking methods than previously used pre-image computation methods (see col. 5, lines 36–40).

44. As to claims 24 and 55, Yang discloses a method wherein at least one external constraint is applied in a lazy manner (see col. 3, lines 18–22).

45. As to claim 58, Yang discloses a method wherein at least one constraint corresponding to initial value of a flip-flop is applied in a lazy manner (see col. 3, lines 18–22).

46. Claims 25, 26, 56, 57, 59, and 60 are rejected under 35 U.S.C. 103(a) as being unpatentable over Baumgartner taken in view of Yang as applied to claims 24, 55, and 58 above; and further in view of Marques-Silva and Sakallah, (Marques-Silva hereinafter), GRASP: A Search Algorithm for Propositional Satisfiability (see reference [6] listed in the specification pg. 3).

47. As to claim 25, while the Baumgartner–Yang method teaches almost all of the instant invention as applied to claim 24 above, the Baumgartner–Yang method lacks at least one constraint corresponding to initial value of a flip-flop applied in a lazy manner.

48. Marques-Silva discloses a method wherein the external constraint is replaced with at least one clause that applies the at least one constraint but does not lead to an immediate implication (see “FDAs” in page 510, col. 2, 2nd paragraph, lines 1–7).

49. Baumgartner, Yang, and Marques-Silva are analogous art because they are related to design verification.

50. Therefore, it would have been obvious to one of ordinary skill in this art at the time of invention by applicant to utilize the step of Marques-Silva in the Baumgartner–Yang method because Marques-Silva develops a procedure for conflict analysis in satisfiability algorithms and describes a configurable algorithm for solving SAT (see page 516, col. 1, next to last paragraph, lines 1–3), and as a result, Marques-Silva reports the following improvement over his prior art: a SAT algorithm more efficient than other state-of-the-art algorithms for a large number of SAT instances (see page 516, col. 1, next to last paragraph, last 3 lines).

51. As to claim 26, Marques-Silva discloses a method wherein the at least one clause includes a dummy variable (see page 518, col. 2, 2nd–5th paragraphs).

52. As to claim 56, Marques-Silva discloses a method wherein the external constraint is replaced with at least one clause that applies the at least one constraint but does not lead to an immediate implication (see “FDAs” in page 510, col. 2, 2nd paragraph, lines 1–7).

53. As to claim 57, Marques-Silva discloses a method wherein the at least one clause includes a dummy variable (see page 518, col. 2, 2nd–5th paragraphs).

54. As to claim 59, Marques-Silva discloses a method wherein the at least one lazy constraint is replaced with at least one clause that applies the constraint but does not lead to an immediate implication (see “FDAs” in page 510, col. 2, 2nd paragraph, lines 1–7).

55. As to claim 60, Marques-Silva discloses a method wherein the at least one clause includes a dummy variable (see page 518, col. 2, 2nd–5th paragraphs).

Conclusion

56. Any indication of allowability of the claims not rejected on prior art is being held in abeyance pending the manner in which applicant amends or responds to the above rejections.

57. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

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58. U.S. Patent 6,944,838 teaches subsequent abstractions based on an analysis of the counterexample found in the previous iteration of an unbounded model checker (see col. 1, lines 45-49).

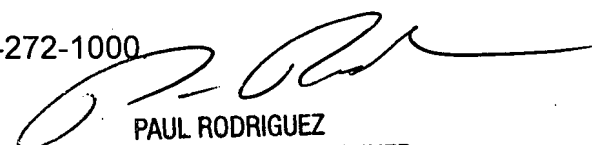
59. Examiner would like to point out that any reference to specific figures, columns and lines should not be considered limiting in any way, the entire reference is considered to provide disclosure relating to the claimed invention.

60. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Juan C. Ochoa whose telephone number is (571) 272-2625. The examiner can normally be reached on 7:30AM - 4:00 PM.

61. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul Rodriguez can be reached on (571) 272-3753. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

62. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

*** JO 5/13/07


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